AECOM CONSULT

M E M O R A N D U M

To: Spokane South Valley LRT Project File

From: Peter Mazurek, AECOM Consult, Inc.

Date: January 17, 2005

Subject: Refinement of Base-year Highway Outputs from Spokane (SRTDM) model

This memorandum provides a summary description of the steps taken in the effort to refine the highway assignment portion of the Spokane Regional Travel Demand Model (SRTDM) in an effort to improve the validation statistics. Although some off-site prior investigation work was performed, the majority of the refinement work was almost entirely performed on-site at SRTC offices during the week of November 29-December 3, 2004, by a collaborative team consisting of SRTC technical staff and AECOM Consult.

The Highway Validation Issue

The SRTDM was developed to suit the region's needs for travel demand analysis to support decisions for transit and highway projects proposed in the region. It was developed to be multi-modal and fully compliant with Federal Transit Administration (FTA) guidelines for the forecasting tools used in support of projects under the FTA Transit New Starts program. The development work was focused on the transit elements of the model, as these were most critical to the Spokane South Valley LRT project which was the impetus for such model development. Although the model was designed to be used in evaluating highway projects as well, the lack of available validation data necessitated that the highway validation receive minimal attention.

In particular, the development of the early model steps (i.e. trip generation and distribution) was limited to adapting SRTC's existing highway model elements (which did not have provision for transit) and making minor adjustments to the trip generation to accommodate transit. In addition, because the fundamental unit of the original SRTC model was vehicle-trips (not person-trips as necessitated by a true multi-modal model), a provision for adjustment was also necessary to adapt the trip generation rates accordingly to produce person-trip ends. Because recent travel pattern data (such as those provided by a home-interview survey or trip-diary study) were not available at a disaggregate level of detail, it was known from the outset that the trip distributions, and the subsequent highway assignments, would be unlikely to achieve a reasonable validation of highway results. Because detailed transit survey data would be available (and in fact would be supplanted by a more recent, detailed survey during the model development process) , a better validation for transit trips was expected (and in fact required for use with FTA New Starts).

An examination of the highway assignment results (traffic forecasts) for the base year (2002 transit system on 2000 highway networks) revealed systemically higher volumes at screenline locations across the board as compared to observed data for those same locations. At the same time, regional VMT appeared quite high, although the target estimates were difficult to evaluate.

The Approach

The approach for improving the model's highway assignment performance to acceptable validation levels was designed as a first-generation, short-term approach. Because of the nature of the trip generation and distribution models (which were ported over from SRTC's older TMODEL-based traffic model), and the fact that these elements were not themselves re-validated to match current trip-making patterns, it was impossible to perform more than cursory adjustments to the process to refine the traffic forecasts to acceptable levels. It is our understanding that a new home-interview survey is planned for the near future; the scope of this effort did not allow waiting for that survey effort to be complete. Therefore, this approach merely made use of what little current observed data were available to adjust the model's trip generation and distribution process until the best available correlation with observed targets was achieved. After that had been done, the mode choice model would be re-calibrated to again match the transit trip pattern targets determined from the 2002 STA On-Board Transit Survey.

The adjustment strategy contained the following basic steps, starting from the latest version of the SRTDM formulation (known as "v4") and networks for the base year 2000/2002:

1. Obtain and set targets for key highway/traffic assignment statistics, including
    a. Intra-zonal Percentage (percent of All trips in region staying within one TAZ).
    b. Daily inter-zonal auto vehicle trips,
    c. PM Peak Hour auto trips,
    d. Regional Vehicle-Miles of Travel (VMT),
    e. Regional Vehicle-Hours of Travel (VHT),
    f. Regional Average Speed,
    g. Total Screenline Observed Volume,
    h. Matches to Observed Screenline Counts,
2. Verify coding of highway networks to a reasonable degree.
3. Perform sensitivity tests on a variety of adjustments to trip generation/distribution.
4. Optimize the correlation with the validation targets with combinations of adjustments
5. Review proposed adjustments and results with SRTC senior staff
6. Re-calibrate mode choice models to re-balance to transit trip targets
7. Re-run model base year forecast using implemented adjustments
8. Re-run future-year transit forecasts for South Valley LRT alternatives to verify minimal change in transit results.

The remainder of this memorandum describes the aforementioned steps in more detail.

Obtain And Set Targets For Key Highway/Traffic Assignment Statistics

AECOM Consult and SRTC technical staff worked cooperatively to set a series of reasonable targets for the base year against which any model results would be judged. These targets were developed based on available traffic data from SRTC, WSDOT, and other sources. The targets were developed jointly by SRTC and AECOM, and presented to SRTC senior staff for review and approval.

The targets developed for this effort are shown in Table 1 below.

Table 1. Highway Assignment Validation Targets

Validation Measure	***Target Value***
Total Person Trip Intra-zonal Percentage:	8.63%
Total Daily Inter-zonal Auto Vehicle Trips:	1,700,000
Peak Hour Auto Vehicle Trips:	151,841
Regional Vehicle-Miles of Travel (VMT):	9,500,000
Regional Vehicle-Hours of Travel (VHT):	230,000
Regional Average Speed (miles/hour):	37.14
Total Observed Screenline Volume:	2,225,226
Individual Screenline volumes	*varies, see Table 3*

Source: SRTC and AECOM Consult

Verify Coding Of Highway Networks To A Reasonable Degree

SRTC undertook some investigation (as part of their ongoing modeling work) to see if there were major issues with how the networks were coded in EMME/2 which would be contributing to the high assignments. The networks for 2000 had been originally developed in TMODEL and rendered into EMME/2 by AECOM Consult as part of the initial model development. Although the conclusion of this investigation was that there were many links on the periphery of the networks which had some odd codings (largely stemming from limitations in the TMODEL software), that these were not likely to impact the highway assignment values significantly as the conversion to EMME/2 had rendered the networks in true distances anyway. Nevertheless the team agreed to perform tests (of subsequent enhancements) with and without the network modifications to assess their impact.

Perform Sensitivity Tests On A Variety Of Adjustments To Trip Generation/Distribution

The team devised over a series of days and model runs a series of possible enhancements to the model formulations. It was anticipated that some combination of these changes would be ultimately implemented, and thus these modifications were tested incrementally to best assess the impact. The following modifications were tested and ultimately implemented as part of the final revisions:

- 33% Reduction in Person Trip Table, post-distribution. This takes 33% off the overall raw trip distribution trip tables immediately after distribution. A variety of adjustment factors were tested, including 10%, 20%, 25%, and 33%.
- Revision of "nearest neighbor" time and distance calculations for intra-zonal cells prior to distribution to 25%. Previously the time and distance for intra-zonal cells (which is impossible for the travel demand model to skim) was set to 75% of the time and distance to the nearest neighbor zone. This yielded too few intra-zonal trips (as a percentage of the total), and the factor was adjusted to 25% to make intra-zonals more attractive.
- Revision of trip distribution friction factor equation, adjusting the distance exponent in the denominator (α) by +0.1.
- Adjustments to time-of-day distribution of auto trips, to increase the percentage of trips in the AM and PM peak periods, and decrease the percentage of trips in the midday and

Night periods. This was based on a revised analysis of temporal distribution data using revised temporal distribution data.

- Adjustments to regional auto occupancy factors applied to auto trips from 1.46 (average) to 1.38 (average). This adjustment was based on some additional occupancy data obtained since the model was developed.

Optimize the Correlation with the Validation Targets with Combinations Of Adjustments
The model formulation was developed to incorporate all of these elements, and tested both with and without the network enhancements mentioned earlier. Although it made little difference which network formulation was used, ultimately it was decided to use the un-modified networks which achieved slightly better validation statistics.

Table 2 shows the validation targets and how the combined model run for the base year compares to those targets. Table 3 shows the traffic data at the individual screenline level. As can be seen, these are much more in line with the observed data than the forecasts prior to the adjustments, which were universally high. Almost all of these are within the NCHRP guidelines for highway assignment validation.

Table 2. Validation Results, Before and After Adjustments

Validation Measure	***Observed***	***Modeled***	
	Target Values	Before Adjustments 11/29/04	After Adjustments 12/01/04
Total Person Trip Intra-Zonal Percentage	***8.63%***	2.55% -70.45%	4.37% -49.35%
Total Daily Inter-zonal Auto Vehicle Trips	**1,700,000**	2,140,204 *25.89%*	1,362,943 *-19.83%*
Peak Hour Auto Vehicle Trips	***151,841***	169,302 *11.50%*	128,722 *-23.97%*
Regional Vehicle-Miles of Travel (VMT)	***9,500,000***	13,695,176 ***44.16%***	8,281,346 ***-12.83%***
Regional Vehicle-Hours of Travel (VHT)	***230,000***	401,459 ***74.55%***	235,114 ***2.22%***
Regional Average Speed (miles/hour)	***37.14***	34.11 *-8.16%*	35.22 *-5.17%*
Total Observed Screenline Volume	***2,225,226***	4,184,738 ***88.06%***	*2,598,465* ***16.77%***
Individual Screenlines	*See Table 3*		

Source: AECOM Consult analysis of SRTC Travel Demand Model *11/29/2004* *12/1/2004*

Table 3. Validations Results at Screenline Level., Before and After Adjustments

Screenline Statistics			*Observed Counts*	*Modeled Base Year Traffic Before Adjustments*		*Modeled Base Year Traffic After Adjustments*	
#	Location	Dir.	*Counts*	*Volume*	*Difference*	*Volume*	*Difference*
1	Suburban Northside	NB	46,354	97,107	*109.5%*	58,189	*25.5%*
		SB	46,253	94,520	*104.4%*	56,393	*21.9%*
		Total	92,607	191,627	*106.9%*	114,582	*23.7%*
2	Middle Northside	NB	89,832	173,391	*93.0%*	108,395	*20.7%*
		SB	87,492	172,777	*97.5%*	108,575	*24.1%*
		Total	177,324	346,168	*95.2%*	216,970	*22.4%*
3	Near Northside	NB	65,210	136,537	*109.4%*	84,170	*29.1%*
		SB	65,013	133,759	*105.7%*	82,246	*26.5%*
		Total	130,223	270,296	*107.6%*	166,416	*27.8%*
4	Spokane River	NB	23,527	48,416	*105.8%*	25,063	*6.5%*
		SB	22,723	22,681	*-0.2%*	13,049	*-42.6%*
		Total	46,250	71,097	*53.7%*	38,112	*-17.6%*
5	Spokane Medical District	NB	27,568	49,385	*79.1%*	32,200	*16.8%*
		SB	26,741	46,125	*72.5%*	29,178	*9.1%*
		Total	54,309	95,510	*75.9%*	61,378	*13.0%*
6	Southside	NB	42,382	64,075	*51.2%*	42,066	*-0.7%*
		SB	43,533	65,887	*51.3%*	42,767	*-1.8%*
		Total	85,915	129,962	*51.3%*	84,833	*-1.3%*
7	Interstate 90	NB	54,403	85,699	*57.5%*	55,441	*1.9%*
		SB	55,524	84,118	*51.5%*	55,571	*0.1%*
		Total	109,927	169,817	*54.5%*	111,012	*1.0%*
8	Sprague Avenue	NB	49,944	101,963	*104.2%*	63,950	*28.0%*
		SB	48,040	102,527	*113.4%*	64,647	*34.6%*
		Total	97,984	204,490	*108.7%*	128,597	*31.2%*
20	Northwest	EB	50,095	88,875	*77.4%*	58,402	*16.6%*
		SB	51,778	71,483	*38.1%*	45,868	*-11.4%*
		Total	101,873	160,358	*57.4%*	104,270	*2.4%*
21	North Central	EB	60,052	122,953	*104.7%*	78,279	*30.4%*
		SB	62,713	110,841	*76.7%*	69,369	*10.6%*
		Total	122,765	233,794	*90.4%*	147,648	*20.3%*
22	NorthEast	EB	36,451	60,904	*67.1%*	37,123	*1.8%*
		SB	33,578	59,945	*78.5%*	36,711	*9.3%*
		Total	70,029	120,849	*72.6%*	73,834	*5.4%*
25	South Central	EB	27,399	28,589	*4.3%*	18,316	*-33.2%*
		SB	27,276	26,842	*-1.6%*	16,694	*-38.8%*
		Total	54,675	55,431	*1.4%*	35,010	*-36.0%*
26	West Valley	EB	38,981	70,012	*79.6%*	41,016	*5.2%*
		SB	34,822	70,997	*103.9%*	40,877	*17.4%*
		Total	73,803	141,009	*91.1%*	81,893	*11.0%*
27	Central Valley	EB	47,704	75,155	*57.5%*	46,203	*-3.1%*
		SB	48,966	77,112	*57.5%*	46,431	*-5.2%*
		Total	96,670	152,267	*57.5%*	92,634	*-4.2%*
All	**Sum of All Screenlines**	**All**	**1,314,354**	**2,342,675**	***78.2%***	**1,457,189**	***10.9%***
				78.2%		***10.9%***	

Source: AECOM Consult, Inc., analysis of SRTC Travel Demand Model

Review Proposed Adjustments and Results With SRTC Senior Staff
The team presented the above results (in slightly more raw tabular form) to SRTC senior staff for their review and approval. They were generally pleased with the results, and this was accepted as acceptance of the process.

Re-Calibrate Mode Choice Models to Re-Balance to Transit Trip Targets
Because of the changes to the trip distribution process, the mode choice models were now seeing significantly reduced trip table inputs. Accordingly, since the total base-year transit trip table was known and did not change, the models needed to be re-calibrated upward so that the new, revised model formulation would still yield the same number of transit linked trips and the transit assignments would yield essentially the same boardings by line. Fortunately, the changes to the mode choice models were minimal, and little change in transit base year performance was seen as a result.

Re-Run Model Base Year Forecast Using Implemented Adjustments
The model was re-run end-to-end for the base year with all of the modifications implemented to ensure that (a) the model process could in fact run end-to-end without errors as a result of the changes, and (b) the results from a complete run were the same as those shown to the SRTC senior staff. Both conditions were in fact true for the base year model run executed on December 2, 2004.

Re-Run Future-Year Transit Forecasts for South Valley LRT Alternatives
The final step was to ensure that the future year transit forecasts were not significantly impacted by all of the changes to the models. The 2025 full alternative set was re-run on December 2, 2004, and the results examined. It is beyond the scope of this memorandum to detail all of the results, but it was noted that forecasts of transit linked trips, LRT/BRT boardings, and Transportation System User Benefits across all the alternatives changed minimally and consistently.